Written Testimony of

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Mr. Chairman and Committee Members, I am pleased to accept your invitation to offer information on climate change along with my own assessment. I am John Christy, Professor of Atmospheric Science and Director of the Earth System Science Center at the University of Alabama in Huntsville.

CARBON DIOXIDE

The concentration of carbon dioxide (CO2) is increasing in the atmosphere due primarily to the combustion of fossil fuels. It is our great fortune (because we produce so much of it) that CO2 is not a pollutant. In simple terms, CO2 is plant food. The green world we see around us would disappear if not for atmospheric CO2. These plants largely evolved at a time when the atmospheric CO2 concentration was many times what it is today. Indeed, numerous studies indicate the present biosphere is being invigorated by the human-induced rise of CO2. In and of itself, therefore, the increasing concentration of CO2 does not pose a toxic risk to the planet. It is the secondary impact of CO2 that may present challenges to human life in the future. It has been proposed that CO2 increases could cause climate change of a magnitude beyond what naturally occurs that would force costly adaptation or significant ecological stress. For example, sea level rise and/or reduced rainfall would be two possible effects likely to be costly to those regions so affected. Data from the past and projections from climate models are employed to provide insight on these concerns.

CLIMATE MODELS

Climate models attempt to describe the ocean/atmospheric system with equations which approximate the processes of nature. No model is perfect because the system is incredibly complex. One modest goal of model simulations is to describe and predict the evolution of the ocean/atmospheric system in a way that is useful to discover possible environmental hazards which lie ahead. The goal is not to achieve a perfect forecast for every type of weather in every unique geographic region, but to provide information on changes in large-scale features. If in testing models for current large-scale features one finds conflict with observations, this suggests that at least some fundamental process, for example heat transfer, are not adequately described in the models.

GLOBAL AVERAGES

A universal feature of climate model projections of global average temperature changes due to enhanced greenhouse gasses is a rise in the temperature of the atmosphere from the surface to 30,000 feet. This temperature rise itself is projected to be significant at the surface, with increasing magnitude as one rises through this layer called the troposphere. Most people use the term Global Warming to describe this temperature rise.

Over the past 21-years various calculations of surface temperature do indeed show a rise between +0.45 and +0.65 °F (0.25 and 0.36 °C depending on which estimate is used.) This represents about half of the total surface warming since the 19th century. In the troposphere, however, the values, which include the satellite data Dr. Roy Spencer of NASA and I produce, show only a very slight warming between +0.09 and +0.18 °F (+0.05 and +0.10 °C) - a rate less than a third that observed at the surface. So, rather than seeing a warming that increases with altitude as climate models project, we see that in the real world the warming substantially decreases with altitude.

It is critically important in my view to correctly model tropospheric temperature changes because this is where much of the global atmospheric heat is moved about and eventually expelled to space. This layer also has a strong influence on surface temperature through radiation processes. It is conceivable that a model which retains too much heat in the troposphere, may also retain too much at the surface.

The most recent modeling attempts which seek to reconcile this disparity suggest that when some of the actual climate processes are factored in, the models come very close to reality. These processes are events such as the Mt. Pinatubo eruption and slow changes such as ozone depletion.

On closer inspection of these studies, however, one finds that the apparent agreement was achieved only by comparing apples with oranges. The model experiments included some major processes, but not all major processes. When those additional processes are also factored in, such as real El Ni±os, the climate models do not produce the observed global average vertical temperature changes observed since 1979. In other words, the temperature of 60% of the atmosphere appears to be going in a direction not predicted by models. That, in my view, is a significant missing piece of the climate puzzle which introduces considerable uncertainty about a model's predictive utility.

It is certainly possible that the inability of the present generation of climate models to reproduce the reality of the past 21 years may only reflect the fact that the climate experiences large natural variations in the vertical temperature structure over such time periods. By recognizing this however, the implication is that any attention drawn to the surface temperature rise over the past two decades must also acknowledge the fact that 60% of the atmospheric mass has not similarly warmed.

REGIONAL AVERAGES

This disparity between observations and model results is a curious and unexplained issue regarding the global average vertical temperature structure. But we do not live 30,000 feet in the atmosphere, and we do not live in a global average surface temperature. We live in specific places, cities, states and regions. Local and regional projections of surface climate are very difficult and challenging. An example from Alabama's past is useful here only to illustrate the difficulty of providing local predictions with a high level of confidence.

A few of the present set of climate models have attempted to reproduce the distribution of actual surface temperatures since the 19th century. These complex models incorporate solar changes, increasing carbon dioxide, sulfate pollution and so on. They indicate that since the 1890's we in North Alabama should have experienced a warming of about 2°F (1°C). The truth is that we have actually experienced a cooling of over 2°F (1°C). The model may have done fairly well in the global average, and may have done acceptably well in many geographic locations, but in my opinion it provided false information for those of us in the Southeast. If in trying to reproduce the past we see such model errors, one must assume that predicting the future would produce similar opportunities for errors on a regional basis.

WEATHER EXTREMES AND CLIMATE CHANGE

I want to encourage the committee to be suspicious of media reports in which weather extremes are given as proof of human-induced climate change. Weather extremes occur somewhere all the time. For example, you may have seen a recent report based on one version of the US surface temperature data stating that January through March of this year was the hottest ever recorded. The satellite data provide information for the entire globe and show that indeed tropospheric temperatures were much above average over the lower 48 states. However, most of the globe experienced below average temperatures in that massive bulk of the troposphere. It was our turn to be warm while in places such as the equatorial oceans and the Sahara Desert it was their turn to be cold.

Has hot weather occurred before in the US? All time record high temperatures by states begin in 1888. Only eleven of the states have uniquely seen record highs since 1950 (35 occurred prior to 1950, 4 states had records occurring both before and after 1950.) Hot weather happens. Similar findings appear from an examination of destructive weather events. The intensity and frequency of hurricanes have not increased. The intensity and frequency of tornadoes have not increased. (Let me quickly add that we now have more people and much more wealth in the paths of these destructive events so that the losses have certainly risen, but that is not due to climate change.) Droughts and wet spells have not statistically increased or decreased. Last summer's drought in the Northeast was remarkable in the sense that for the country as a whole, the typical percentage area covered by drought was below average. Deaths in US cities are no longer correlated with high temperatures, though deaths still increase during cold temperatures.

When considering information such as indicated above, one finds it difficult to conclude the climate change is occurring in the US and that it is exceedingly difficult to conclude that part of that change might have been caused by human factors.

In the past 100 years, sea level has risen 6 in. ± 4 in. (15 cm ± 10 cm) and is apparently not accelerating. Sea level also rose in the 17th and 18th centuries, obviously due to natural causes, but not as much. One of my duties in the office of the State Climatologist is to inform developers and industries of the potential climate risks and rewards in Alabama. I am very frank in pointing out the dangers of beach front property along the Gulf Coast. A sea level rise of 6 in. over 100 years, or even 50 years is minuscule compared with the storm surge of a powerful hurricane like Fredrick or Camille. Coastal areas threatened today will be threatened in the future. The sea level rise, if it continues, will be very slow and thus give decades of opportunity for adaptation, if one is able to survive the storms.

SUMMARY

I will close with three questions and a plea.

Is the climate changing? Yes, it always has and it always will, but it is very difficult to detect on decadal time scales or on regional spatial scales.

Are climate models useful? Yes, and improving. At this point, their utility is mostly related to global averages, though shortcomings are still apparent.

Is that portion of climate change due to human factors good, bad or inconsequential? No one knows (although the plant world thrives on increases in carbon dioxide because CO_2 is plant food.)

What we do know is that we depend on data to answer these questions. The global data network is decaying at the very time we need it most. If the richest country in the world could do something, it would be to lead out in monitoring the present climate, in reconstructing the past climate, in assuring easy and timely access to the data S and in supporting scientists to study the data on which depend such important answers.

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